

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a perspective view of a system of devices for treating a superficial venous disease, such as spider veins using a light-reactive agent, the agent being suited for intravenous injection.

[0014] FIG. 2 is a perspective view of the system shown in FIG. 1 packaged as a kit, with directions for using the devices to treat a superficial venous disease.

[0015] FIGS. 3A and 3B are side section views, taken generally along line 3-3 in FIG. 1, showing alternative embodiments of the internal components of a photoactivation device that forms a part of the system shown in FIG. 1.

[0016] FIGS. 4 to 14 show a representative method of using a system like that shown in FIG. 1 to treat spider veins.

[0017] FIG. 15 shows an alternative embodiment of a source of a light-reactive agent usable with the system shown in FIG. 1, the agent being in tablet or capsule form, for oral ingestion.

[0018] FIG. 16 shows an alternative embodiment of a source of a light-reactive agent usable with the system shown in FIG. 1, the agent being in cream form for topical application.

[0019] FIG. 17 shows an alternative embodiment of a source of a light-reactive agent usable with the system shown in FIG. 1, the agent being in a band aid form for topical application.

[0020] FIGS. 18A, 18B, and 18C show alternative embodiments of a photoactivation device that can form a part of the system shown in FIG. 1.

[0021] FIGS. 19 and 20 show the treatment of ears of New Zealand White Rabbits by injecting into the superficial venous anatomy light-reactive agent LS11 (Talaporfin Sodium) in doses selected to approximate a human dose, and thereafter exposing the superficial venous anatomy to light at a wavelength of 664 nm in doses ranging from 8 to 12 minutes.

[0022] FIG. 21 shows visible alterations in the superficial venous anatomy of a rabbit ear treated as shown in FIGS. 19 and 20 due to shrinkage of vein dimensions.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structures. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

[0024] The systems, methods, and devices disclosed herein are directed to the distribution of a selected reactive agent at, in, or near an inner wall of a vein. The selected reactive agent is characterized in that it can be reliably and controllably activating in situ by the application of a prescribed form of energy. Once distributed to the targeted site, the reactive agent can be activated in situ by applying the prescribed form of energy. The activation of the reactive agent, causes localized injury to the inner wall of the vein.

The prescribed form of energy can comprise, e.g., electromagnetic radiation, and, more particularly, electromagnetic radiation in the wavelength spectrum comprising light energy. The devices and system, and their associated methods of use, are particularly well suited for treating superficial venous diseases, such as spider veins.

[0025] FIG. 1 shows representative devices that together comprise a system 10 for treating a vascular disease or a dysfunction affecting the vascular system using light-reactive agents, i.e., reactive agents that are activated by light energy. The devices and system 10, and their associated methods of use, using light-reactive agents are particularly well suited for treating superficial venous diseases, such as spider veins. For this reason, the devices and system 10, and their associated methods of use will be described in this context.

[0026] Still, it should be appreciated that the disclosed devices and system 10, and their associated methods of use are applicable for use in treating other diseases or dysfunctions elsewhere in the body that are not necessarily related to spider veins or their cause, but are nevertheless capable of treatment by light-reactive agents carried by blood. Other conditions that can be treated by light reactive agents using the system 10 or a form of the system 10 include cancer, e.g., breast or prostate cancer; conditions of the ear, nose, or throat; periodontal disease; and conditions of the eye or sight (ophthalmology).

[0027] As FIG. 1 shows, the system 10 includes at least one source 12 of a selected light reactive agent 14. The source 12 can be provided in various forms. For example, as shown in FIG. 1, the source 12 can comprise a conventional vial 16 containing the light reactive agent 14 in solution suited for intravenous injection. Alternatively, the source 12 can comprise the light reactive agent 14 packaged with a carrier in tablet or capsule form for oral ingestion; or incorporated into a cream that can be applied topically to the skin.

[0028] The light reactive agent 14 can comprise any light-reactive drug suited for photodynamic therapy (PDT). PDT is a treatment that uses an agent or drug, also called a photosensitizer or photosensitizing agent, and light energy of a particular selected wavelength. The photosensitizers, which are inert by themselves, bind to proteins found in blood, e.g., lipoproteins. The proteins act as carriers, transporting the photosensitizers to cells targeted for treatment. When exposed to light of the particular wavelength (which varies according to the photosensitizer), the photosensitizer reacts with oxygen. The reaction transforms the oxygen into singlet oxygen and free radicals. The singlet oxygen and free radicals disrupt normal cellular functions and cause cell death.

[0029] The light reactive agent 14 can be selected among a group of photosensitizers, depending upon type and location of tissue being treated, as well as the mode contemplated for its introduction into body tissue. Each photosensitizer is activated by light of a specific wavelength. This wavelength determines how far the light can travel into the body. Thus, the physician can select a specific photosensitizer and wavelength(s) of light to treat different areas of the body.

[0030] The photosensitizer selected desirably possesses all or some of the following clinically relevant criteria: a